

9/23: Energy, and Systems

Chapter 2, Cont'd

2-4 What is Energy and How Can It Be Changed? Core Concepts

- **Concept 2-4A** *When energy is converted from one form to another in a physical or chemical change, no energy is created or destroyed (first law of thermodynamics).*
 - **Concept 2-4B** *Whenever energy is changed from one form to another, we end up with lower-quality or less usable energy than we started with (second law of thermodynamics).*
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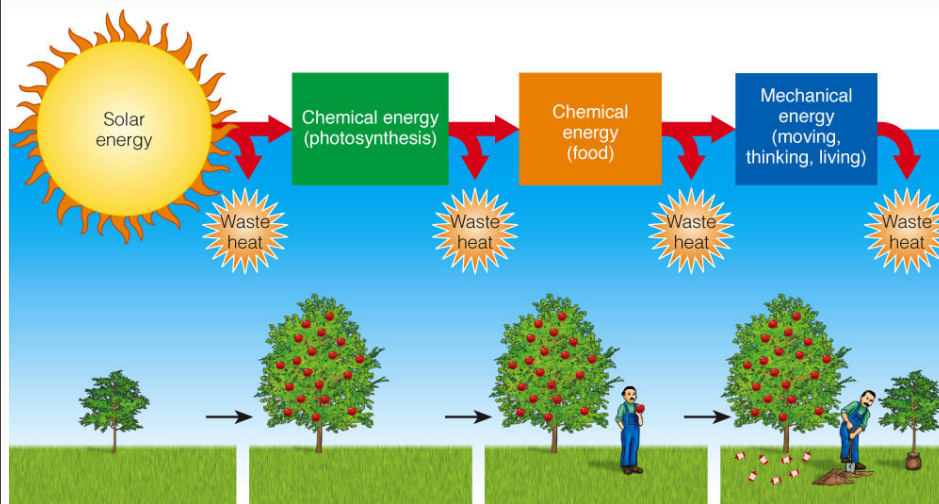
Energy Comes in Many Forms

- **Kinetic energy**
 - Movement!
 - Transferred by radiation, conduction, or convection
 - Electromagnetic radiation (waves)
 - **Potential energy**
 - Stored energy
 - Can be changed into kinetic energy
 - Gravitational, chemical,
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HEAT as Energy

- Eureka Video (yes, this is dated...but it's *good!*)
 - Molecules in liquids
 - Heat vs. Temperature
 - **Guiding Questions**
 - How is thermal energy *kinetic energy*?
 - What did we mean by saying the ocean has a low quality energy but a high quantity of energy?
 - How is “Heat” different from “Temperature”?
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The Second Law of Thermodynamics in Living Systems



Systems

- **Open vs. Closed**
- The Second Law of Thermo can seem to be broken only in open systems
- Go back to the preclass and consider whether each is open or closed.

Formative Assessments

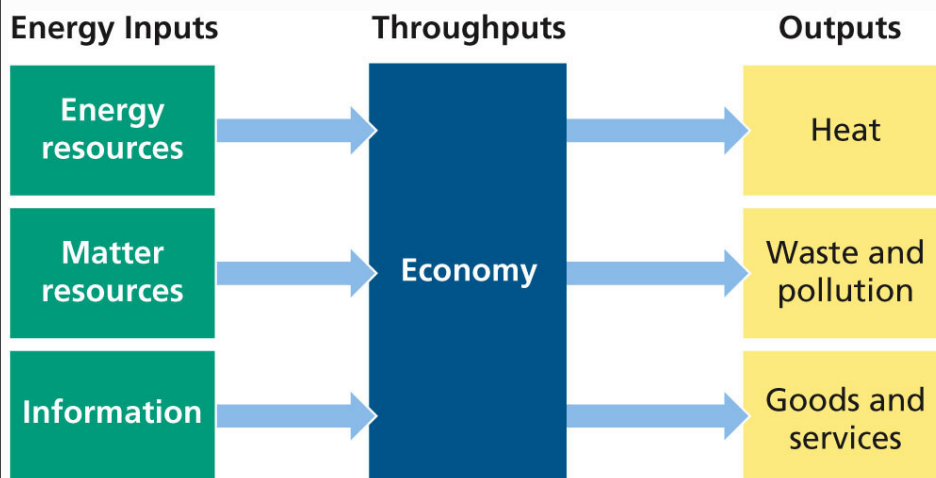
- Seedlings in a Jar

 - The Rusty Nails
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Systems Have Inputs, Flows, and Outputs

- **System**
 - Inputs from the environment
 - Flows (throughputs)
 - Outputs
 - → It's like a "Function" in math
 - you put something in
 - the function does something to it
 - Something different comes out
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Inputs, Throughput, and Outputs of an Economic System



2-5 What Are Systems and How Do They Respond to Change?

- **Concept 2-5A** Systems have inputs, flows, and outputs of matter and energy, and their behavior can be affected by feedback.
- **Concept 2-5B** Life, human systems, and the earth's life support systems must conform to the law of conservation of matter and the two laws of thermodynamics.

Today

- Review topics from Ch 2 for Wednesday's test
 - Graphing review
 - Make your bar graph and a draft of your conclusions
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Energy Changes Are Governed by Two Scientific Laws

- **First Law of Thermodynamics**
 - Energy input always equals energy output
 - **Second Law of Thermodynamics**
 - Energy always goes from a more useful to a less useful form when it changes from one form to another
 - Entropy = measure of disorder in a system
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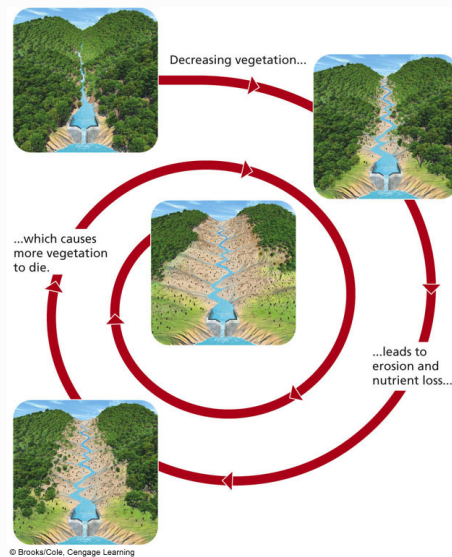
Some Types of Energy Are More Useful Than Others

- **High-quality energy**
 - Concentrated
 - Useful to us
 - Easy to harness and use to do work
 - Ex: coal and other fossil fuels
 - **Low-quality energy**
 - Diffuse (spread out)
 - Difficult for us to harness for doing work
 - Ex: the heat in the ocean
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Ch 2 Topics

- Scientific method
 - Paradigm shift
 - Chemistry Review
 - Subatomic particles
 - Acid ←----- pH = 7 -----→ Alkalinity (Base)
 - Molecules & chemical formulas
 - Physical & chemical changes
 - Nuclear changes (fusion vs. fission)
 - Biology Review
 - Genes, cells, DNA
 - Macromolecules
 - lipids (fats), carbs, proteins, nucleic acids
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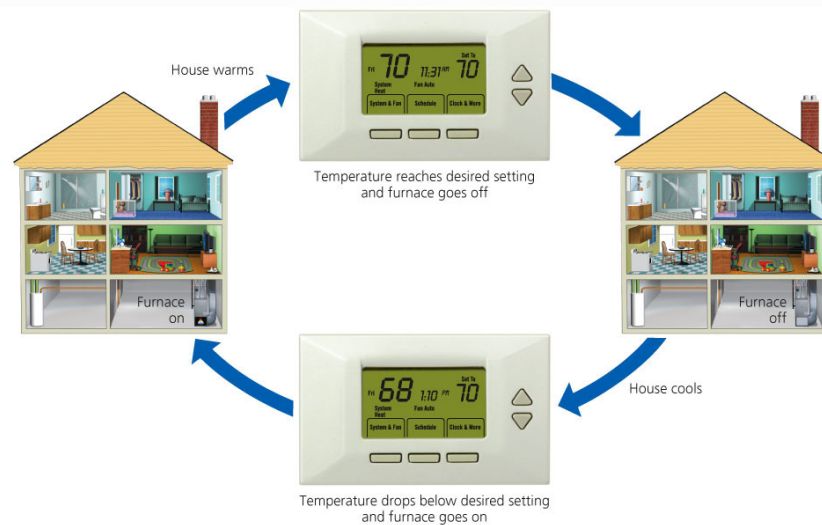
Positive Feedback Loop



Systems Respond to Change through Feedback Loops

- **Positive feedback loop:** amplifies the effect
 - Ex: Cutting down trees → more erosion → more trees die → more erosion
- **Negative feedback loop:** lessens the effect
 - “Corrective”
 - Thermostat

Negative Feedback Loop



Time Delays Can Allow a System to Reach a Tipping Point

- **Time delays vary**
 - Between the input of a feedback stimulus and the response to it
- **Tipping point, threshold level**
 - Causes a shift in the behavior of a system
 - Ex: A chain reaction or run-away inflation
 - Ex: the atmosphere of Venus had run-away greenhouse effect...it's HOT there!